PA 1197596

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

July 22, 2004

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: ***60/487,947***
FILING DATE: ***July 18, 2003***

By Authority of the
COMMISSIONER OF PATENTS AND TRADEMARKS

T. LAWRENCE

T. LAWRENCE
Certifying Officer

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

07/21/2003 KBETEMA1 00000072 195113 60487947
01 FC:2005 80.00 DA

PTO-1556
(5/87)

*U.S. Government Printing Office: 2002 — 489-267/69033

Please type a plus sign (+) inside the box → [+]

PTO/SB/16 (2-98)
Approved for use through 01/31/2001. OMB 0651-0037
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

INVENTOR(S)

Given Name (first and middle [if any])	Family Name or Surname	Residence (City and either State or Foreign Country)
Miousse	Danielle	268, Bernadette, Ste-Julie (Québec), Canada, J3E 1G6
Biasotto	Fabienne	3525, rue Swail # 12, Montréal (Québec), Canada, H3T 1P5
Labbé	Serge	Longueuil, (Québec), Canada

☐ Additional inventors are being named on the separately numbered sheets attached hereto

TITLE OF THE INVENTION (280 characters max)

NEW OXIDATION PROCESS FOR WATER TREATMENT

CORRESPONDENCE ADDRESS

Direct all correspondence to:

☒ Customer Number 020988 → 020988

OR *Type Customer Number here*

PATENT AND TRADEMARK OFFICE

☐ Firm or Individual Name					
Address					
Address					
City		State		ZIP	
Country		Telephone		Fax	

ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification *Number of Pages* 8 ☐ Small Entity Statement

☒ Drawing(s) *Number of Sheets* 3 ☐ Other (specify)

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)*

☐ A check or money order is enclosed to cover the filing fee

☒ The Commissioner is hereby authorized to charge filing Fees or credit any overpayment to Deposit Account Number: 19-5113

FILING FEE AMOUNT ($): $80.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,

SIGNATURE _____ Date July 18, 2003

TYPED or PRINTED NAME Christian Cawthorn REGISTRATION NO. *(if appropriate)* 47,352

TELEPHONE (514) 847-4256 Docket Number: 16598-1uspr

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14.

New oxidati n process for water treatment

BACKGROUND OF THE INVENTION

(a) Field of the Invention

[0001] This invention relates to a new oxidation process for the treatment of water, more specifically for the treatment of industrial process effluents.

(b) Description of Prior Art

[0002] The commercially available techniques for treating an effluent containing penetrant are mostly separation techniques. Filtration using activated carbon will provide satisfactory results with regard to the removal of the organic charge. However, the activated carbon is saturating quickly, resulting in high maintenance and disposal costs. Membrane filtration is also providing satisfactory results with regard to the removal of the organic charge, but is having the drawback of requiring high investment and maintenance costs.

[0003] It is known to use coalescers for removing oils and fat content from water. However, this method is not providing elimination of dissolved compounds and solid particles in suspension.

[0004] It is also well known to use ozone for treating penetrant containing effluents. This technique is efficient for removing the color of the penetrant, but is not adapted to reach high levels of reduction of the penetrant in water.

[0005] Bactericide capacity of UV is well known for treating water. UV rays having a wavelength of 254 nm are known to alter the chemical structure of the constituents of living cells. This leads to a dysfunction of the cell resulting in sterilization and destruction of the cell. The drawback of this technique is that the UV action is not remanent. UV treatment at 254 nm must therefore be used in combination with another treatment. UV treatment at 185 nm is less used and is a more recent development. UV lamps can produce oxidative species that are highly reactive like ozone and hydroxyl-radicals. UV treatment is mostly used in the optic field to degrade organic matter and reduce the organic carbon content in water.

[0006] It is highly desirable to develop a new process for the treatment of an industrial effluent, more specifically an effluent containing penetrants.

SUMMARY OF THE INVENTION

[0007] In accordance with the present invention there is provided a process for the treatment of water containing an organic contaminant, said process comprising the steps of:

(a) adding hydrogen peroxide to the water; and

(b) irradiating the water with ultraviolet rays during a sufficient time for allowing decomposition of the contaminant until the treatment is achieved. However, the process can be initiated by step (b) followed by step (a) or having steps (a) and (b) performed simultaneously without prejudice to the quality of the water treatment.

[0008] The ultraviolet rays are preferably of a wavelength of 185 nm.

[0009] In one embodiment of the present invention, the contaminant is miscible with water.

[0010] In another embodiment of the present invention, the contaminant is selected from the group consisting of fluoresceine, benzene or derivative thereof, phenol or derivative thereof and hydrocarbon.

[0011] In a further embodiment of the present invention, a step of passing the water in a coalescer precedes step a).

[0012] In a still further embodiment of the present invention, the hydrogen peroxide is added until an phase separation is initiated. The phases are preferably separated into an aqueous phase and an organic phase, this organic phase is more preferably passed into a coalescer to isolate the oils contained in it.

[0013] In the present invention, it is intended that the duration of the treatment should be interpreted as being the circulation time in the UV reactor in presence of H_2O_2 that is necessary to obtain an emulsion comprising an organic phase (oil) and an aqueous phase.

[0014] The treatment of the water is intended to mean the treatment of the water in order to obtain a treated water having a reduced concentration

of contaminant, or a complete elimination of the contaminant, in order to satisfy local environmental requirements.

[0015] The charge of the equivalent aqueous phase is the concentration of total organic carbon of the aqueous phase after separation from the organic phase.

[0016] The term "volume of H_2O_2 required" is intended to mean the H_2O_2 volume that must be added initially in the reactor per liter of solution for treatment.

[0017] It is intended in the present application that the term "Equivalent organic charge" means the concentration of total organic carbon corresponding to the concentration in volume percentage (volume of contaminant per volume of solution).

[0018] It is also intended in the present application that the term "Total organic carbon (TOC)" means the sum of all organic carbon present in a solution.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Fig. 1 illustrates a diagram of the steps of the process of the present invention;

[0020] Fig. 2 illustrates a flow-chart diagram of the process of Fig. 1; and

[0021] Fig. 3 illustrates the variation of TOC with time for different solutions having various TOC initial concentrations.

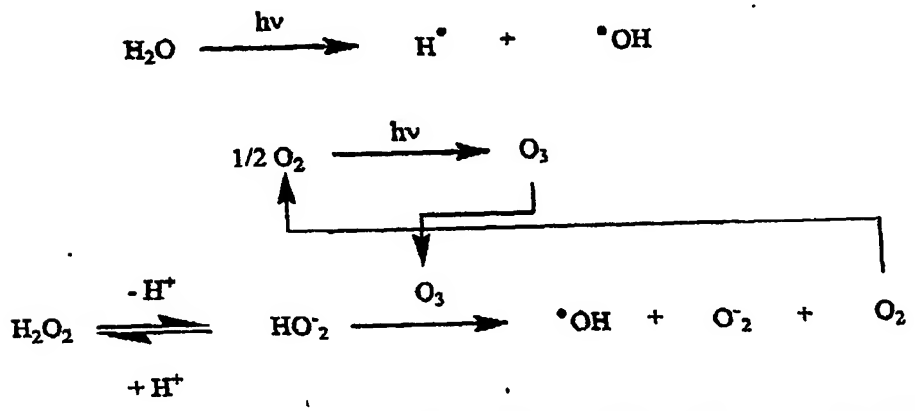
DETAILED DESCRIPTION OF THE INVENTION

[0022] In accordance with the present invention, there is provided a new process for treating an effluent contaminated with organic matter using the combined effect of hydrogen peroxide (H_2O_2) and irradiation by UV rays (185 nm).

[0023] The process of the present invention combines the use of ultraviolet (UV) rays and the use of hydrogen peroxide to treat contaminated water. This water can be contaminated by an organic compound such as, but not limited to, fluorescein. This water is often characterized by an undesirable color, a variable organic charge, an

absence of suspended matter and a fatty content being outside the acceptable limits for discarding in a wastewater system (30 mg/L).

[0024] In the process of the present invention, the UV treatment is coupled with the degradation effect of hydrogen peroxide. When the hydrogen peroxide is coupled to UV, the action of ozone on the dissociated form of peroxide generates hydroxyl-radicals and oxygen. These compounds attack the organic matter and propagate the chain radical mechanism as per the formula:



[0025] Fig. 1 illustrates the process used which is dependent on the initial Total Organic Carbon (TOC) measure. For TOC measures greater than 15 mg/L and less than 600 mg/L, the effluent is treated with UV at 185 nm and H_2O_2 is performed until the TOC value is less than 15 mg/L. The treated water can then be sent to wastewater. For TOC measures over 600 mg/L, two treatment phases are performed. In a first step, the water is treated with UV at 185 nm and H_2O_2 until an emulsion is formed. Table 1 provides the treatment time necessary to obtain phase separation for a three liter volume of a solution containing a certain fraction of contaminated water. When the emulsion is formed, the solution passes in a coalescer in a second step, thereby providing separation of the aqueous liquid phase and the fatty liquid phase. The fatty liquid phase can then be retrieved and properly disposed. The aqueous liquid phase is having at this stage a TOC content lower than 600 mg/L and the second step of

treatment consisting of UV and H_2O_2 treatment is performed as previously described.

Table 1

Treatment time for phase separation in a 3 liter solution

contaminated water concentration	TOC (ppm)	Treatment time	H_2O_2 volume (mL)	TOC of the aqueous phase (ppm)
0.15%	710	30 min	5	≈ 230
0.20%	930	40 m in	6.7	≈ 280
0.25%	1100 – 1200	50 min	8.3	≈ 300
0.30%	1400	1 hour	10	≈ 350
1%	4300-4600	3 hours	23.8	≈ 600
2.5%	11000	-	23.8	≈ 1200
5%	22000	15 hours	47.6	≈ 2500

[0026] Proper dilution of the water effluent to be treated, or repetition of steps 1 and 2 can be provided, until a satisfactory TOC value is achieved, preferably under 15 mg/L.

[0027] Fig. 2 shows the details of the process of the present invention.

Transfer of the effluent from the recuperation tank to intermediate tank

[0028] The transfer of water to be treated is made from a recuperation tank (10) by a pump (12). The pumped water passes through a filter (14) and a coalescer (16). The filter (14) is used to eliminate large particles and to avoid damage to the equipment. At the exit of the coalescer (16), the residual water is transferred in the intermediate tank (18) by gravity and the oil is directed to an oil recuperation tank (20)

[0029] The intermediate tank (18) allows the accumulation of the non-treated water that may occur in the case of a prolonged interruption of the treatment. The homogenization of the water is provided by the pump (22)

and the gate (24). This recirculation allows a significant value of TOC to be achieved.

Transfer of the effluent from the tampon tank to the UV reactor

[0030] The volume of water is controlled by the pulsed flow meter (22) and is directed to the UV reactor (28) through the pump (22) and the gate (30). A fraction of the volume can be directed to a tank (32). The filling of the reactor (28) is provided by the captor (34) and the opening of the gate (36). Recirculation is provided in the reactor by the action of the pump (38).

Treatment of the water with a phase separation

[0031] The duration of the treatment depends on the TOC concentration of the effluent. The quantity of H_2O_2 that must be added to the water is proportionally related to the initial TOC. Examples are given in Table 1.

[0032] Upon introduction of H_2O_2, a certain amount of time is necessary to allow for the formation of an emulsion comprising an organic phase and an aqueous phase. Upon formation of the emulsion, the water is passed into a second coalescer (40) through a pump (42) and a gate (44). The pump (42) is preferably having a small flow rate to avoid disruption of the emulsion.

[0033] At the exit of the second coalescer (40), the organic phase is sent to the oil recuperation tank (20) and the aqueous phase is sent back to the UV reactor (28). H_2O_2 is added to the aqueous solution and UV radiation at 185 nm is applied. The TOC value is monitored and the treatment with H_2O_2 and UV rays continues until the TOC value meets the required value. The treated water is then returned back to the tank (32) to be eventually sent to the wastewater.

Treatment of the water without a phase separation

[0034] If the initial TOC value is under a predetermined limit, preferably 600 mg/L, the water is treated as previously mentioned with the exception that only one pass is performed in the UV reactor (28) and that no passage is performed in the second coalescer (40).

[0035] Fig. 3 illustrates the variation in TOC with time for solutions having various TOC initial concentrations. It can be observed that the addition of the phase separation step allows the treatment of solutions having a high TOC initial concentration in about the same time as needed for solutions having a lower TOC initial concentration.

[0036] While the invention has been described in connection with specific embodiments thereof, it will be understood that it is capable of further modifications and this application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice within the art to which the invention pertains, and as may be applied to the essential features hereinbefore set forth, and as follows in the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A process for the treatment of water containing a contaminant, said process comprising the steps of:

(a) adding a sufficient quantity of hydrogen peroxide to the water; and

(b) radiating the water with ultraviolet rays during a sufficient time for allowing decomposition of the contaminant until said treatment is achieved.

2. The process of claim 1, wherein said ultraviolet rays are of a wavelength of 185 nm.

3. The process of claim 1, wherein said contaminant is miscible with water.

4. The process of claim 1, wherein said contaminant is selected from the group consisting of fluoresceine, benzene or derivative thereof, phenol or derivative thereof and hydrocarbon.

5. The process of claim 1, wherein step a) and step b) are performed simultaneously.

6. The process of claim 1, wherein said process is initiated with step b) followed by step a).

7. The process of claim 1, further comprising a step of passing the water in a coalescer before step a).

8. The process of claim 1, wherein said hydrogen peroxide is added until an phase separation is initiated.

9. The process of claim 8, further comprising a step of separating said emulsion into an aqueous phase and an organic phase after step b).

10. The process of claim 9, further comprising a step of passing said organic phase into a coalescer to isolate oils contained in said organic phase after the step of separating.

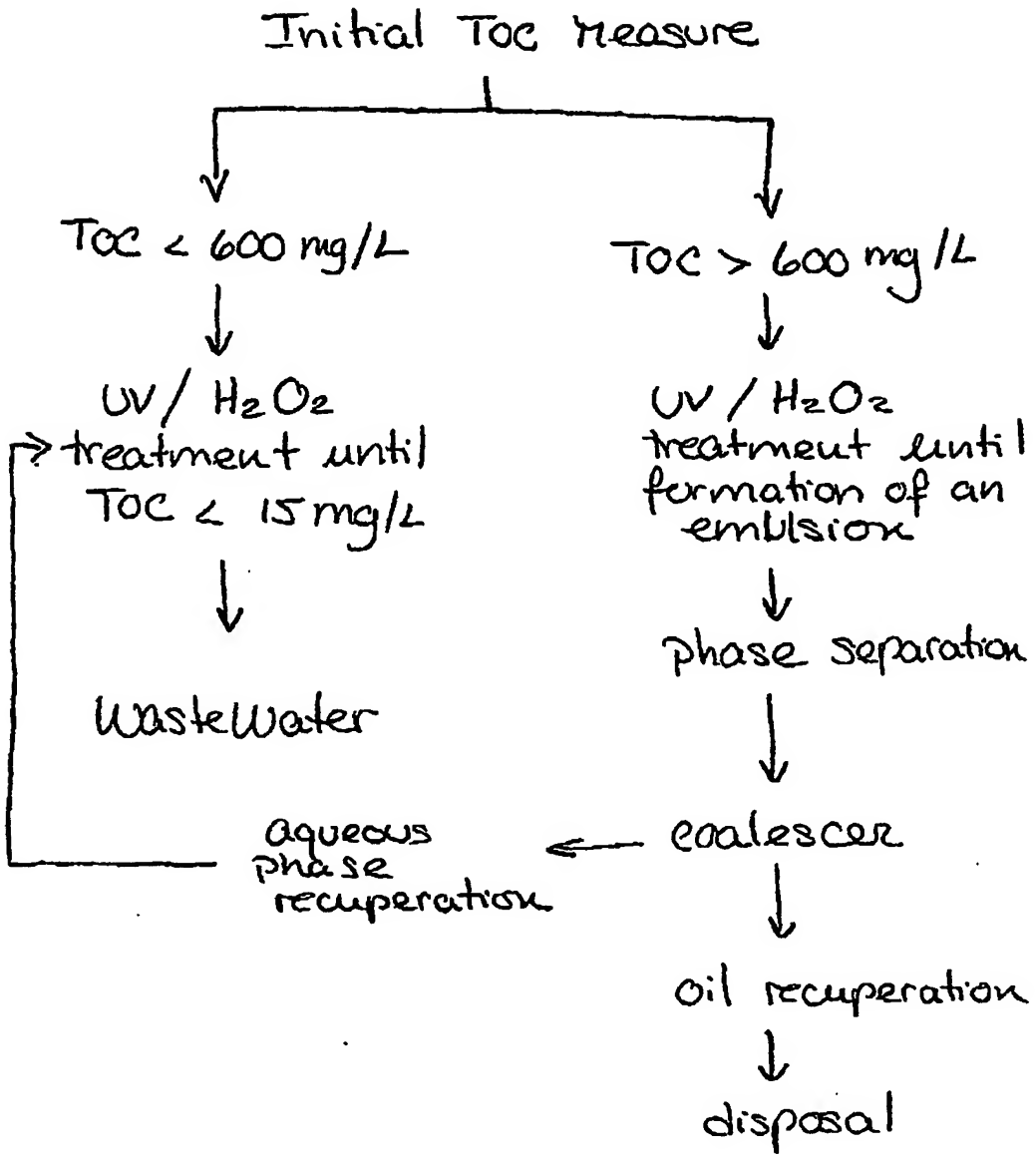

Initial Toc measure
TOC < 600 mg/L
TOC > 600 mg/L
UV / H2O2 treatment until TOC < 15 mg/L
UV / H2O2 treatment until formation of an emulsion
Wastewater
phase separation
coalescer
aqueous phase recuperation
oil recuperation
disposal

FIG. 1

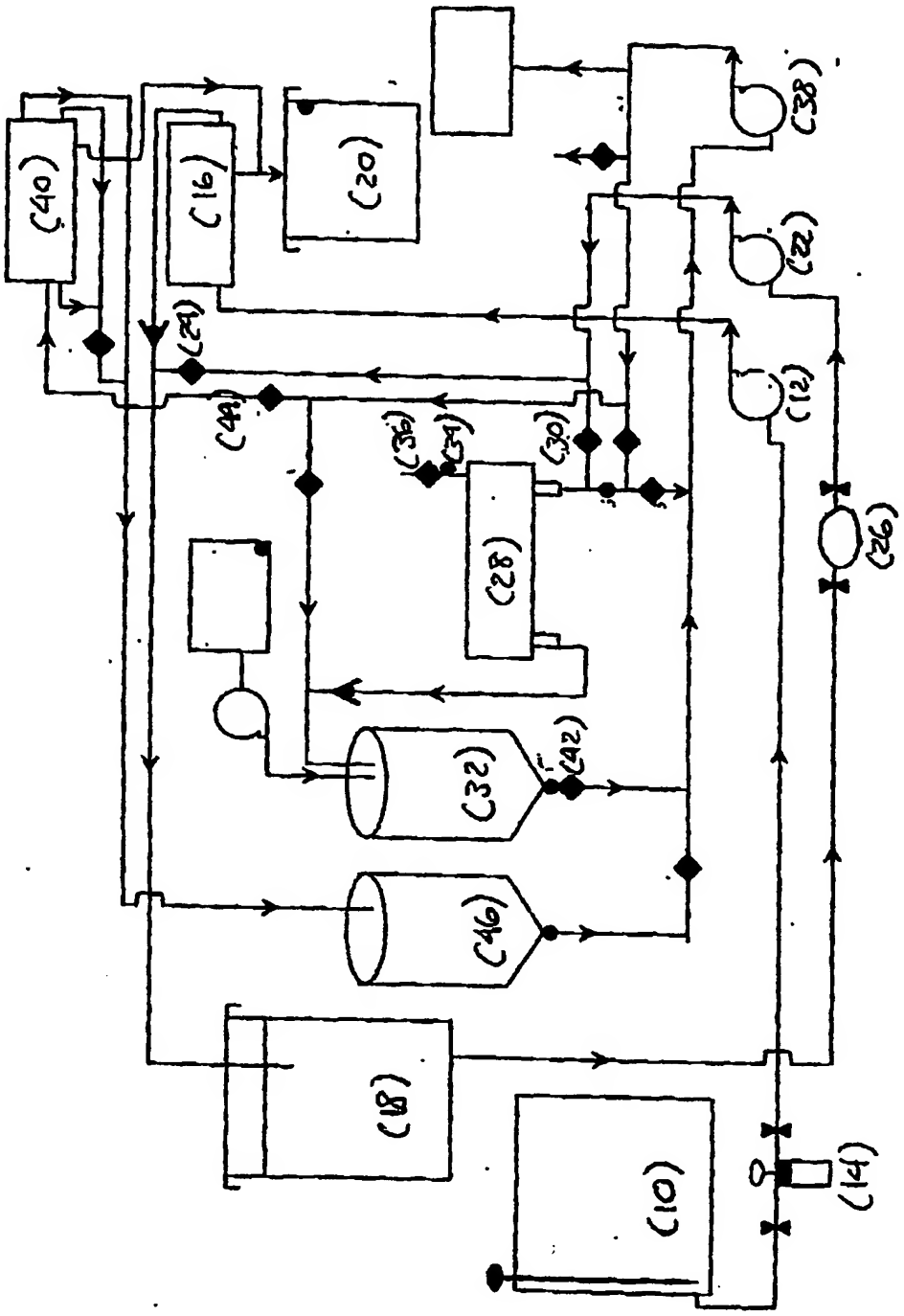


FIG. 2

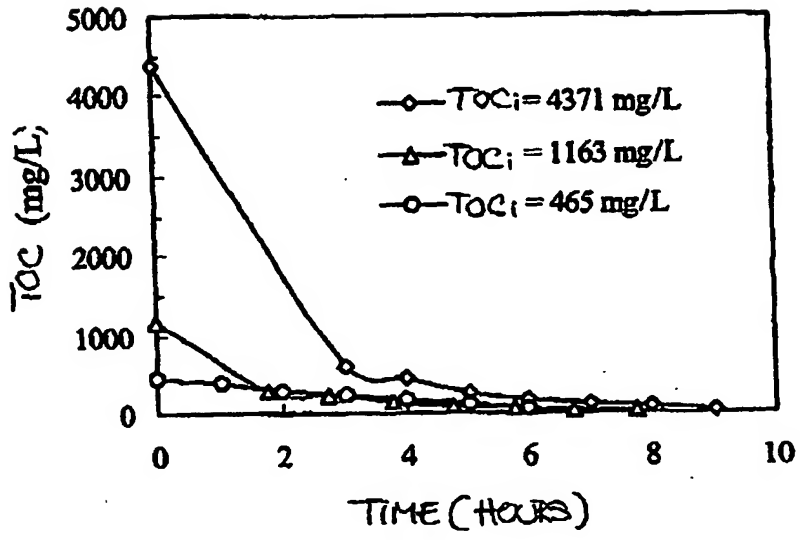

5000
4000
3000
2000
1000
0
TOC (mg/L)
0
2
4
6
8
10
TIME (HOURS)
TOCi = 4371 mg/L
TOCi = 1163 mg/L
TOCi = 465 mg/L

Fig. 3